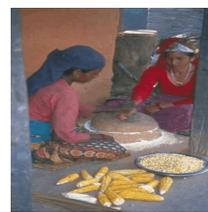


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Introduction

Every spring in the Himalayan mountains of Nepal, farmers plow their terraced fields and plant maize (*Zea mays*), an American crop plant. Nepalese farmers plant yellow-seeded maize, orange, red, white, and multi-colored maize. Women grind the grain for a thick porridge to be eaten with lentils and vegetable curries at the two main meals of the day. Field workers carry popcorn and pots of fermented maize beer for their midday lunch. Farmers feed green maize stalks to their water buffaloes and goats when other fodder becomes scarce during the spring dry season. Dried maize stalks and husks are used for weaving fencing and mats. And during the ceremonies of the autumn harvest festival of *Dasain*, villagers wear *tikas* of rice and yogurt on their foreheads and pale yellow seedlings of maize in their hair.



In March 1972, I watched farmers plowing and planting maize in Lamjung district in Nepal, where I was a Peace Corps science teacher. In my two-room stone house, I sat by the wood fire and ate maize porridge with lentils and mustard greens. As I ate my maize, I wondered how an American crop plant had become a staple food in a remote region of the Himalayas. My neighbors were convinced that their maize, or *makai*, was "local", and only one among the many crop plants, such as rice, millet, and buckwheat, that actually are indigenous to the Himalayas. They believed that maize and other American crop plants like the chili peppers and tomatoes they used in their curries had been with them from ancestral times. After I left Nepal in 1973, I pursued a career in scientific research on fungal diseases of maize and wheat in the United States, but I also returned to Nepal on four more occasions. In 1993 I began field work on fungal diseases of maize in Nepal in collaboration with scientists at the Nepal Agricultural Research Council. But 30 years after I first saw maize being planted in Lamjung, I still had no satisfactory answer to my questions about the introduction of maize to Nepal. To answer these questions, I began a collaboration with Susan McCarthy, a plant physiologist and agricultural historian, to research the history of maize in Asia. In this article we present our first discoveries of early journeys of maize to Asia. We hope that our study will serve as a foundation for future research.

This article begins with the discovery of maize in Mesoamerica by Columbus in 1492. Subsequent chapters follow the journeys of maize eastward, as *milho*, *makka*, and *yu mai*, to Europe, Africa, Asia, and Australia. Each chapter section begins with a general description of the types of evidence we have discovered for each geographical region, then continues with specific references to maize in general chronological order. We have focused as much as possible on the earliest records from the 16th to 18th centuries, and we have included 19th century material only when earlier data are scarce. Because many of the older source texts may be difficult for the general reader to obtain and because they often contain no subject indexes, we have provided numerous direct quotations and page numbers for specific references. We have not edited quotations to correct or modernize spelling, but we have simplified some quotations by omitting capitals except on proper nouns. Within quotations, brackets indicate original material and parentheses indicate material we have added. Because neither of us has the linguistic skills to read Portuguese, Spanish, African, or Asian languages, we have relied on English and French translations of texts in those languages. Otherwise, we have made a serious effort to use direct eye-witness accounts and other primary sources.



We are grateful for the assistance of many librarians, especially Joyce Blumenshine and Michelle Yoder at the National Center for Agricultural Utilization Research, Miguel Garcia at the Royal Botanic Gardens Sydney, Louise Anemaat at the State Library of New South Wales and Toni Swann at the National Agricultural Library. We thank Mercedes Panizzi for translation

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Anne E. Desjardins

Chapter 1. Teosinte and mahiz in Mesoamerica

The only center of domestication of maize, *Zea mays ssp. mays*, worldwide is Mesoamerica, the region of central and southern Mexico and adjacent areas of Central America. The prairies, open woodlands, and roadsides of Mesoamerica also are the only native habitat of several closely related wild *Zea* species that are called teosintes, a common name derived from the Aztec language of Guatemala ⁽¹⁾. Teosinte species such as *Zea mays ssp. parviglumis* and *Zea mays ssp. mexicana* are the closest relatives of maize and the probable ancestors of domesticated maize ⁽²⁾.

Origin of Maize

In central Mexico, *Zea mays ssp. mexicana* is a troublesome weed of maize fields where, until flowering, the plant can be difficult to distinguish from domesticated maize ⁽³⁾. The ears and seeds of teosintes and maize, however, are profoundly different. Whereas the maize ear bears hundreds of naked seeds that remain attached to the ear at maturity, teosinte species bear about a dozen seeds in an ear that shatters at maturity. Each teosinte seed is completely covered by a very hard and lustrous triangular fruitcase, giving it the general appearance of a small gray or brown pebble.

Despite differences in ear and seed morphology, teosinte and maize are genetically closely related. All species of teosinte can form hybrids with maize under natural conditions. Crosses of maize with the annual teosintes *Z. mays ssp. mexicana* and *parviglumis* are highly fertile, and progeny demonstrate a range of morphological traits intermediate between the parents. Maize geneticist John Doebley and colleagues have used crosses of maize and teosinte to show that relatively few genes, with large effects on traits such as seed shattering



and the size of seeds and fruitcases, are involved in transformation of the teosinte ear into the maize ear ⁽⁴⁾.

Such genetic evidence supports the close relationship between teosinte and maize that was first proposed by 19th century European botanists who first studied teosinte. Joseph Hooker grew teosinte plants in the greenhouse of the Royal Gardens at Kew, England in 1878. Hooker wrote "that from a botanical point of view *Euchlaena* (teosinte) is a most interesting genus, from its being the nearest congener of maize, whose American origin it thus supports"⁽⁵⁾.

Darwin on Maize in Peru

Nineteenth century botanists also proposed the great antiquity of maize cultivation in the Americas. During his 5-year voyage around the world on HMS Beagle, Charles Darwin found ancient heads of maize on the coast of Peru. Darwin later wrote in *Animals and Plants under Domestication* that "*Zea mays*...is undoubtedly of American origin, and was grown by the aborigines throughout the continent from New England to Chili. Its cultivation must have been extremely ancient, for Tschudi describes two kinds, now extinct or not known in Peru, which were taken from the tombs apparently prior to the dynasty of the Incas. But there is even stronger evidence of antiquity, for I found on the coast of Peru heads of maize, together with eighteen species of recent sea-shell, embedded in a beach which had been raised at least 85 feet above the level of the sea. In accordance with this ancient cultivation, numerous American varieties have arisen...maize has varied in an extraordinary and conspicuous manner"⁽⁶⁾. Recent archaeobiological studies of maize cobs and pollen, and of maize phytoliths (microscopic structures of silica) in food residues in potsherds and on ancient human teeth, indicate that Native Americans domesticated maize in Mexico more than 6200 years ago ⁽⁷⁾.

Aztec Records of Maize and Teosinte

Despite the early domestication of maize in Mesoamerica and its widespread cultivation by Native Americans, written records of maize and of teosinte are rare in pre-Columbian America. The Incas of Peru and the other native South Americans had no known system of writing, and the written literature of the Maya civilization of Yucatan and Guatemala was almost completely destroyed by Friar Diego de Landa in a great bonfire in 1562. Surviving pre-Columbian documents in the Nahuatl language of the Aztecs of Mexico occasionally mention *cincocopi* (teosinte), as in "Quezacoatl put his wife, Chalchiuhtlicue, to be the sun. During the time Chalchiuhtlicue was the sun, the people ate a seed like maize which they called cincocopi"⁽⁸⁾. Aztec documents from this era also contain numerous figures of the maize plant and of agricultural practices connected with it, along with stylized representations of maize and deities such as the maize god Cintéotl and goddess Chicomecoatl ⁽⁹⁾.

Among the early Spanish explorers to the Americas were priests, government officials, and other educated men who wrote substantial accounts of the significance of maize in Native American life ⁽¹⁰⁾. The Spanish Friar Bernardino de Sahagun arrived in Mexico in 1529 and, during the remaining 60 years of his life there, learned the Nahuatl language of the Aztecs, compiled Nahuatl documents, and translated them into Spanish. His *Historia general de las cosas de Nueva Espana* was completed in 1576 and contains a description and illustration of teosinte. "There is a plant very similar to maize called cocopi...this herb grows in the maize field, it is not sown, some grow before planting, and others after planting. It grows in-between maize like rye-grass in a wheat field"⁽¹¹⁾. Sahagun's *Historia* and another old manuscript *El primer nueva coronica y bien gobierno*, which is illustrated with many drawings, describe maize, as well as agricultural practices, use of food plants, and other aspects of everyday life among the Aztecs.

Chapter 2. Turkische korn in Europe

Christopher Columbus and the other explorers of the Spanish fleets first introduced maize into Europe, but we have no eyewitness records of the exact circumstances of the occasion. Although Columbus and some of his educated officers wrote logbooks and letters describing their travels, few of those documents have survived ⁽¹²⁾. The main source of information about Columbus'voyages in the Americas is the *Vida del Almirante Cristobal Colon* by his illegitimate son Hernando Columbus, who accompanied his father on his fourth voyage. The *Vida* is available in an Italian version published in 1571, but the original Spanish version is lost. Other sources are the accounts of Spanish royal historian Fernandez de Oviedo, who began publishing his multi-volume *Historia general y natural de las Indias* in 1535, and Friar Bartolome de las Casas, whose *Historia de las Indias* was begun about 1527, but not published in its entirety until the 1800s.

Columbus on Maize in the Bahamas (1492)

On his first voyage of 1492-93, Columbus and his fleet of three ships reached the islands of the Bahamas, Cuba, and Hispaniola (now Haiti and the Dominican Republic). Columbus'original log-book of the voyage is lost, but apparently was used by his son Hernando and by las Casas. The only surviving original document of the first voyage is a summary account written by Columbus during his return voyage to Lisbon, which makes no mention of maize. According to las Casas, in 1492 at Fernandina Island in the Bahamas, Columbus observed that "this island is very green, flat and fertile and I have no doubt that they sow and reap Indian corn and other crops throughout the year", and in Cuba he reported that "they had seen many fields ... also of a grain like panic-grass that the Indians call maize. This grain has a very good taste when cooked, either roasted or ground and made into a gruel"⁽¹³⁾. From their first explorations in the

Caribbean islands, the Spanish adopted the Native Arawak word *maiz* or *mahiz* as one of their names for *Zea mays*. In 1753, when Linnaeus named maize according to his new binomial system, he combined the Greek word *Zea*, meaning grain, with the adopted Arawak word for the species name *mays* ⁽¹⁴⁾.

Origin of Name of Maize

Columbus returned to the Americas in 1493 with 17 ships and several thousand men, many of them in hopes of finding gold in the islands of the Caribbean Sea. On this second voyage from 1493 to 1496, Columbus reached Martinique and Jamaica, but no logbook has survived. Twelve ships of the fleet returned to Spain in 1494, carrying a letter written somewhere in the Caribbean region by Guglielmo Coma. Some of Coma's observations were included in a Latin pamphlet published in 1494 by Nicolo Syllacio in Pavia, Italy, and the plant described is undoubtedly maize, "There is also a prolific kind of grain, the size of a lupin, rounded like a chickpea. When broken it produces a fine flour, and it is ground like wheat. A bread of excellent flavor is made from it"⁽¹⁵⁾. The second book of the 1511 edition of *De Orbe Nouo Decades* by Pedro Martir de Angleria, an Italian scholar at the Spanish court, is addressed to a church dignitary and dated at the Spanish court in 1494. This book includes an account of the second voyage and the statement "The bearer [of this letter] will also give you, in my name, certain white and black grains of wheat from which they make bread [maiz]." According to Paul Weatherwax, these two documents from 1494 are the first known records of maize in Europe ⁽¹⁶⁾.

First Records of Maize in Europe

The third voyage of Columbus from 1498-1500 explored the northeast coast of South America from Trinidad to the mouth of the Orinoco River (now Venezuela). Columbus' 1498 account of this voyage includes a description of the natives of the Orinoco region "They brought in bread and various kinds of fruit and different wines... Some of it must be made from maize, which is a cereal with an ear like that of wheat. I have brought some back and there is now much in Castile. The best is apparently considered excellent and most prized"⁽¹⁷⁾. On his fourth and final voyage in 1502-04, Columbus explored several locations along the mainland coast of Central America from Honduras to Panama. Although Columbus' accounts of this voyage contain no mention of maize, "his brother Diego, who accompanied him on this voyage, reported that in one place in Central America, he had traveled for 18 miles through fields of maize"⁽¹⁸⁾.

The Spanish conquests continued with military actions by Cortez against the Aztecs in Mexico in 1521, by Alvarado against the Maya in Guatemala in 1526, and by Coronado against

native Americans as far northwest as New Mexico by 1540. Maize was undoubtedly exported from Mexico, Guatemala, and Columbia, all areas with a great diversity of land races of maize. The conquest of the Inca empire of Peru by Pizarro by 1533 allowed the export of Peruvian varieties of maize, varieties that are noted for extreme diversity, including maize with giant seeds, interlocking cobs, and extremely long and flexible cobs ⁽¹⁹⁾. Import of Peruvian maize into Spain is supported by the use of the Peruvian word *zara* as an early name for maize in Spain ⁽²⁰⁾.

Cassava - The Bread of Brazil

Maize probably was taken by Portuguese traders from Brazil to Europe and to the western coast of Africa after 1500, but the times and places of its introduction are not known. In 1500, the Portuguese explorer Pedro Alvares de Cabral, en route to India, landed at Porto Seguro on the eastern coast of Brazil. After ten days trading with native tribes along the coast, one ship returned to Lisbon while Cabral and the remaining fleet of 12 ships continued on to Africa, the Cape of Good Hope, Mozambique, Madagascar, Mombasa, and eventually to Calicut on the western coast of India. Records of this voyage are scarce and there is no information on whether the Portuguese observed maize in Brazil or carried it on their continuing voyage to Africa and India. In a letter, Cabral commented on the natives of the Brazil coast "nor do they eat anything except these manioc (*Manihot esculenta*, also called cassava), of which there is much, and of the seeds and the fruits which the earth and trees produce"⁽²¹⁾.

Portuguese agricultural colonization of Brazil did not begin until the 1530s and long remained confined to a coastal strip less than 30 miles wide. Manioc, rather than maize, was the staple food of both the natives and the early Portuguese settlers, and sugar and tobacco (*Nicotiana tabacum*), rather than maize, were the main export crops of the Portuguese agricultural colonies through the 16th and 17th centuries ⁽²²⁾. On his first voyage to coastal Brazil in 1593, the English slave trader Richard Hawkins reported cassava as the bread of the country, and pineapples (*Ananas comosus*) and potatoes (probably the sweet potato, *Ipomoea batatas*). Hawkins made no mention of maize on the coast of Brazil, even though earlier on the same voyage he had described maize in the Cape Verde Islands ⁽²³⁾. One hundred years later, in 1699, the English privateer William Dampier observed both roots and maize as staple foods at Bahia on the coast of Brazil ⁽²⁴⁾. But even as late as 1768, on his voyage in HMS Endeavor with Captain James Cook, botanist Joseph Banks noted that cassava was the only bread of Rio de Janeiro and its fishermen, "their provision for the sea consisted of a cask of water and a bag of flour of cassada which they call farinha de pao or wooden flour, a very proper name for it which indeed tastes more like powdered chips than anything else "⁽²⁵⁾.

Maize in Spain

Maize appears to have been introduced first into Spain. In 1498 Columbus wrote that maize was being grown in Castile ⁽²⁶⁾. In the 1525 edition of the *Historia* of Ovieda, there is mention of maize growing near Madrid ⁽²⁷⁾. In a later edition of 1535, Ovieda wrote "I saw in that city (Avila), which is one of the coldest in Spain, inside a house a good plot of maize with stalks about ten hands high as stout and green and as beautiful as can be seen around here; near by was a well from which they watered it each day. I was really astounded, remembering the distance and the difference in climate of this region [the Indies] from that of Avila... The event took place in 1530 A.D." ⁽²⁸⁾. In the early 16th century maize spread from Spain throughout the countries of Southern Europe, Northern Africa, and the Middle East that border the Mediterranean Sea, and to northern Europe. Weatherwax notes that Schweinfurth in 1904 described a specimen of maize collected in Italy by Gherardo Cibo in 1532 as the oldest herbarium specimen of the plant in existence ⁽²⁹⁾.

Early Confusion on Origin of Maize

Because many of Columbus' contemporaries still believed that the Americas were part of the Asian continent, they erroneously thought that maize originated in Asia. The Ottoman Empire of Turkey dominated trade in the Mediterranean Sea and the Middle East at that time, thus maize often was called *Turkische korn* or Turkish wheat in the European botanical literature, or Herbals, of the 16th century. Maize was first described in the 1539 first edition of the Herbal of the German botanist Jerome Bock, who believed that the plant probably came from India. Bock described maize ears with silks, husks, and eight to ten rows of kernels, and with kernels of red, brown, yellow or white, but included no illustration of maize in the first edition of his Herbal ⁽³⁰⁾. Then, in 1542 another German botanist, Leonhard Fuchs, published his Herbal *De historia stirpinum*, which included a beautiful woodcut of an entire maize plant with ears and tassels, the first illustration of maize in Europe ⁽³¹⁾. Fuchs wrote that maize was growing in all gardens in Germany and described ears with eight to ten rows of kernels, and with kernels of red, white, yellow or purple, but he still believed that the plant was brought into Germany from Asia by the Turks ⁽³²⁾.

Early Diversity of Maize in Europe

After Magellan's circumnavigation of the world in 1522 and the publication of selected literature of American exploration, European botanists began to question the Asian origin of maize. The Italian botanist Pierandrea Mattioli appears to have had access to the *Historia* of Oviedo and the works of others who had traveled in the Americas ⁽³³⁾. In his 1565 Herbal, Mattioli wrote "Among the kinds of wheat may be counted that grain which some erroneously call Turkish. Erroneously, I say, because it ought to be called *Indian*, not Turkish, for it came from the West Indies, not from Turkey or Asia as Fuchs says"⁽³⁴⁾. Mattioli described maize ears with eight to ten rows of kernels and kernels of red, black, white, brown, purple or yellow, and also described some maize plants that required 40 days for maturity and others that required two months ⁽³³⁾. In his 1950 text *Maize in the Great Herbals* John Finan documented the precision and detail of the descriptions of maize in the collection of European Herbals in the library of the Missouri Botanical Garden. Finan concluded that botanists of the 16th century observed, described, and illustrated a great diversity of types of maize: ears of different shapes; ears with different numbers of rows of kernels; ears with kernels of different colors such as black, purple, red, blue, gold, yellow, and white, and with speckled and other mixed-colored kernels; ears with kernels of different shapes such as flat, round, long, or pointed kernels; plants with and without prop roots, plants with single stalks or with multiple stalks, plants with different numbers of ears, and dwarf plants and other unusual types ⁽³⁵⁾.

Diverse Opinions of Maize

Maize was first grown in European gardens as an agricultural curiosity, and early Herbals differed considerably in their opinion of the grain as a human food. In 1597 the English botanist John Gerarde published his English translation of the Latin *De frugum historia* of Rembert Dodoens. In his *Herballe* Gerarde added some new material including a description of maize, "Turkey wheate doth nourish far lesse than either wheate, rie, barley or oates. The bread which is made thereof is meanly white, without bran: it is hard and dry as bisket is, and hath in it no clammenes at all: for which cause it is hard of digestion, and yieldeth to the body little or no nourishment"⁽³⁶⁾. In contrast, John Parkinson wrote in his 1640 *Theatrum Botanicum* that "although the grain be dry, yet the meale thereof... hath in it some clamminesse, which bindeth the bread close and giveth good nourishment to the body, for wee finde both the Indians and the Christians of all nations that feede thereon, are nourished thereby in as good manner no doubt as if they fed on wheate in the same manner"⁽³⁷⁾. In certain regions of southern and eastern Europe,

maize became established as an important food grain by the end of the 17th century, giving rise to diets based on maize breads and on maize porridges such as the polenta of Northern Italy.

Chapter 3. Mahindi and milho in Africa

Maize was cultivated in Africa by the mid-1500s, but the dates and circumstances of the early introductions of maize into Africa are not known. Examination of words for maize in the many African languages and dialects indicates that maize came to Africa directly across the Atlantic but also by way of Egypt and Arabia⁽³⁸⁾. Names for maize in northern and central Africa include *maheende*, *mahindi*, and *mase*, which probably are imitations of the Caribbean word maize that was adopted by Columbus⁽³⁹⁾. The Portuguese word *milho* for maize survives as *mielie* or *mealies* in languages of sub-Saharan Africa, where maize was introduced by Portuguese traders.

Confusing Synonyms for Maize

Early Portuguese accounts and those of other European travellers to Africa are an important source of information on the introduction of maize and other American food crops. 16th and 17th century records contain references to maize under a number of names, including variations of *mais* or *mehiz*, Indian corn, and Turkish wheat or Guinea wheat. Early references are sometimes ambiguous because terminology for cereal grains was imprecise. In particular, the English word "corn" could refer to a wide variety of cereal grains, and variations of the Portuguese name *milho* for maize also could refer to millet (*Eleusine*, *Pennisetum*, and others) or sorghum (*Sorghum bicolor*). The *Thesouro da Lingua Portugeza* of 1871-1874 listed *milho zaburro* and *milho grosso* as 19th century synonyms for *Zea mays*, although *milho zaburro* is currently used by the Portuguese to refer to sorghum or millet⁽⁴⁰⁾.

Early Maize in West Africa

The earliest reference to maize on the western coast of Africa is an ambiguous report of *milho zaburro*, which could indicate maize or sorghum, by the Portuguese writer Valentim Fernandes in 1502⁽⁴¹⁾. In 1526, Al-Hassan Ibn Mohammed Al-Wezaz, also known as Leo Africanus, wrote of his travels in the region between the rivers of Gambia and Senega, " Their

chiefe sustenance is zaburro, otherwise called Ghinie-wheate or maiz, which they sow after the inundation of their rivers, casting some quantity of sand thereupon to defend it from the heat, which otherwise would scorch the ground too excessively"⁽⁴²⁾. The Muslim traveller also reported "maize or Ghiny-wheat" as a food for slaves near the Congo River, and *saburro* on Saint Iago in the Cape Verde Islands on the west African coast⁽⁴³⁾. Sometime between 1535 and 1550, an anonymous Portuguese pilot saw what was probably maize on the Cape Verde Islands, the Island of Sao Tome, and other Portuguese settlements along the western coast of Africa; he stated that the grain was the size of a chickpea, and was known as *mehiz* in the West Indies⁽⁴⁴⁾. In 1593, Richard Hawkins described maize in the Cape Verde Islands "the bread which they spend in these ilands, is brought from Portingall and Spaine, saving that which they make of rice, or of mayes, which we call Guynne-wheate"⁽⁴⁵⁾.

Maize and the Slave Trade

During four voyages to the western coast of Africa in 1605-1612, Dutch trader Pieter Van Der Broecke reported that Angola was a "fertile land with all sorts of mantimentous namely mile masse or Turkish wheat" which the translator notes were Dutch names for maize in the 17th and 18th centuries⁽⁴⁶⁾. Van der Broecke also noted the abundance of pineapples, another plant native to the Americas. The French slave trader Jean Barbot wrote a lengthy account of his travels on the western coast of Africa in 1678-79 and 1681-82 with numerous observations of maize as a subsistence crop from Senegal to Gabon and in the Congo-Angola region. Barbot noted that maize ears were roasted in the embers as a dish for the upper ranks and that maize grains were parched on hot stones and were also ground and boiled to prepare bread called kankies (cakes). Barbot observed native rituals and other practices associated with maize, including a "ceremony of prayer to the fetish, in order to bring rain upon the maize, which greatly needed water"; officers of the army wearing shields decorated with maize and hats decorated with maize cobs; and women using maize straw to make hampers, baskets, and other utensils, which they ornamented and decorated with cowrie shells⁽⁴⁷⁾. Barbot noted the use of maize as a travel provision for the native army, and also purchased maize on the Gold Coast as provision for his slave ship⁽⁴⁸⁾.

Early Maize in Mozambique

Early reports of maize on the eastern coast of Africa are centered on regions near the island of Mozambique which was a major way station for the *Carreira da India*, the Portuguese route between Lisbon and Goa on the western coast of India. Maize was reported as a staple food in the Portuguese community in Mozambique in 1561⁽⁴⁹⁾. In 1601, English Captain James Lancaster landed on the coast of Africa adjacent to the island of Mozambique where he "took three or foure barkes of Moores..., laden with millio (a possible reference to maize), hennes, and

ducks, with one Portuguese boy, going for the provision of Mozambique⁽⁵⁰⁾. When his fleet was stranded at Mozambique island in 1619, Portuguese



Leguate (1891)

Captain Ruy Freye de Andrada sent a ship to the island of Sao Lourenco (now Madagascar) "so that it might take in a supply of meat, rice and Indian corn, which they did in great abundance and with great dispatch"⁽⁵¹⁾. French traveller Francois Leguat in 1691 reported that Indian corn grew very well on the Island of Mauritius (now Reunion) to the east of Madagascar ⁽⁵²⁾. In the mid-18th century the Franciscan priest Remedius Prutky and a Monsieur de Gentil noted that "Indian corn" or "maize" was plentiful on the island of Mauritius and that the inhabitants used maize as food for themselves and for their slaves, as barter for wheat, and as feed for the hogs and poultry they raised for the ship trade ⁽⁵³⁾. By the mid-1600s, maize also was being grown at Mombasa in Kenya and at other Portuguese trade settlements scattered along the eastern coast of Africa ⁽⁵⁴⁾.

Early Maize in Abbyssinia [Ethiopia and Eritrea]

Following its introduction into Spain by 1495, maize spread rapidly throughout the Mediterranean coast along the well-established trade routes between Christian Europe and Muslim North Africa, Turkey, and the Middle East. Grigg ⁽⁵⁵⁾ stated that the Turks brought maize to Egypt in 1517, but provided no historical details. In the narrative of his travels in Africa published in 1553, the Portuguese Joao de Barros reported *zaburro* (a possible reference to maize) on the north coast of Africa ⁽⁵⁶⁾. The muslim traveller Al-Hassan Ibn Mohammed Al-Wezaz wrote in 1526 of Ethiopia, "the countrie... bringeth forth barley and myll [for it aboundeth not greatly with other sortes of grain] and likewise taffo da guza (*Eragrostis tef*), another good and durable seed: but there is mill, and zaburro [which we call the graine of India, or Ginnie wheat] great plenty "⁽⁵⁷⁾. Further evidence for the early cultivation of maize in Ethiopia is provided by the journal of Father Francisco Alvarez, a member of the 1520-1527 Portuguese

embassy to the Coptic Christian regions of the Abyssinian highlands (now Ethiopia and Eritrea). After leaving the port of Masawa on the western coast of the Red Sea, Alvarez described monasteries with fields of "Indian corn" and gardens with "trees of all kinds, both of Portugal and India ". At monasteries at Bisam and elsewhere, the monks ate bread "of maize and barley, and other grain which they call taffo, a small black grain " and "in this country they make bread of any grain, as with wheat, barley, maize, pulse, peas, lentils, small beans, beans, linseed, and teff " ⁽⁵⁸⁾. Alvarez appears to have distinguished maize, as Indian corn or *milho zaburro*, from millets (*Eleusine* species) to which he gave the local names of *mashela* and *dagousha*. In 1623 botanist Casper Bauhin reported maize in Ethiopia ⁽⁵⁹⁾, as did Prutky in 1751, "Ethiopia is full of the grain known in Europe as maize" and "for want of teff they make do with maize flour" for preparation of bread ⁽⁶⁰⁾. The preparation of bread from a mixture of maize and other grains was also noted by John Covel, British chaplain at Constantinople, during a stop on the coast of Tunisia in 1669, "There was also store of bread to be bought. They make some of it of pure good wheat, most of it of millet, some of what we call Turkish wheat, much of barley flour" ⁽⁶¹⁾.

Chapter 4. Makka in the Middle East and South Asia

Linguistic evidence indicates that Turkish, Arab, and other Muslim traders played an important role in dissemination of maize in the Middle East and South Asia. Common vernacular names for maize in the Near East, such as *surratul-makkah* in Arabic and *gaudume-makka* in Persian, are variations of "grain of Mecca" ⁽⁶²⁾, indicating an association with the Muslim holy city of Mecca on the east coast of the Red sea in present-day Saudi Arabia. Yearly pilgrimages to the shrine of the Kaaba at Mecca and to the nearby holy city of Medina have facilitated trade and cultural exchange throughout the Muslim world for more than a thousand years.

Grain of Mecca

Muslim historians and the few European travellers in the Middle East region during the 16th and 17th centuries wrote rarely about agriculture and left few accounts of introduced American crop plants other than tobacco, which spread rapidly in the Muslim world ⁽⁶³⁾. The journals of John Fryer, Father Barthelemy Carre and other Europeans who traveled in the Middle East from 1635 to 1680 record widespread tobacco smoking and tobacco gardens in present-day Syria, Iraq, and Iran ⁽⁶⁴⁾. The records and herbarium of Bavarian botanist Leohard Rauwolf document the presence of maize in Iraq in 1574. From 1573 to 1575, Rauwolf traveled along the trade routes from Tripoli to Aleppo in Syria and along the Euphrates and Tigris River routes to Bagdad in Iraq. In fields near Jerusalem, Aleppo, and near the Euphrates River, Rauwolf observed "Indian millet [maize]...six, seven or eight cubits high" ⁽⁶⁵⁾. Rauwolf collected specimens for his herbarium at the University of Leyden in Germany and in 1755, botanist Johann Friedrich Gronovius used the new binomial system of Linnaeus to classify plants from the Rauwolf herbarium ⁽⁶⁶⁾. Gronovius identified as *Zea mays* a sample that Rauwolf had collected at Bir in Iraq in 1574 and had labeled as *Turkisches Korn* ⁽⁶⁷⁾. In his travels in Iran and

Pakistan in the 1890s, British counsel Percy Sykes noted that maize was an important summer crop in the Kerman region and that maize stalks were a source of fodder for horses in the Baluchistan desert along the coast of the Arabian Sea ⁽⁶⁸⁾.

Rauwolf Finds Maize in Iraq

Maize was cultivated in South Asia by the mid-1600s, but the dates and circumstances of the first introductions of maize into Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka are not known. The few available sources of information include genealogical histories and natural histories written by South Asians, and the accounts of the rare European travellers who made observations of South Asian agriculture. Although Europeans are likely to have played a role in early introductions of maize into South Asia, the Spanish name *mahiz* and the Portuguese name *milho* do not appear to have survived as names for *Zea mays* in any of the South Asian languages. In contrast, linguistic evidence strongly supports a role for Arabs and other Muslim traders in introducing maize into South Asia. The majority of vernacular names for maize throughout South Asia from the 1600s to the present day are variations of *makka*, grain of Mecca. Examples include *makka* and *mukka* in Hindi and Rajasthani; *makai* in Bengali, Punjabi, Gujarati and Nepali; *makaibonda* in Maharashtra; *mukka-cholam* in Tamil; *mokka-jonnalu* in Telugu, etc. ⁽⁶⁹⁾. In ethnological studies conducted in the 1840s and 1850s, Brian Hodgson ⁽⁷⁰⁾ found *makai* to be the name for maize among 16 of 23 languages or dialects of aboriginal tribes in the remote hill regions of eastern Nepal and northeastern India.

Loss of Early Portuguese Records in India

Few documents of 16th and 17th century Portuguese history in India have survived, and fewer still deal with agriculture and other domestic issues. Asian historian Charles Boxer wrote that "the amount of relevant material to be found in the Portuguese archives is disappointingly small, most of the contemporary documents and reports having perished in the great fire which destroyed the building in which they were housed, the Casa da India, after the disastrous Lisbon earthquake of 1755; whilst the white ant has been responsible for the destruction of many old documents in the Goa archives"⁽⁷¹⁾. European and Indian accounts relate that in 1498, 1500 and 1502 Portuguese ships under Vasco da Gama and Pedro Alvares Cabral crossed the Arabian Sea from Africa and reached the Malabar coast of southern India. The Portuguese seized Arab trading ships, looted their cargoes of Malabar black pepper and other spices, killed most of their crews, and returned with the spices to Europe. The 16th century Portuguese soldier Duarte Pacheco wrote "with these [his fleets] he [king Manuel of Portugal] has conquered and daily conquers, the Indian seas and the shores of Asia, destroying and burning the Moors of Cairo, of Arabia and of

Mecca, and other inhabitants of the same India, together with their fleet, by which for over 800 years they have controlled their trade in precious stones, pearls and spices"⁽⁷²⁾.

Gardens of Goa

In their efforts to control the supply of spices to Europe and to control and tax inter-Asian shipping trade, the Portuguese established strategic bases for their naval fleets and trading operations along the western coast of India. In 1510 Alfonso de Albuquerque captured the island of Goa from the Sultan of Bijapur, and there established the capital of the *Estada da India*. By 1524 Goa had become a thriving trading settlement of 450 Portuguese householders, where Portuguese men were encouraged to marry Indian women who converted to Christianity ⁽⁷³⁾. Dutch traveller John Huyghen Van Linschoten described Goa in the 1580s as "well builte with [faire] houses and streetes, after the Portingall manner, but because of the heat they are somewhat lower. They commonly have their gardens and orchards at the backe side of their houses, full of all kinde of Indian fruites "⁽⁷⁴⁾. English merchant Ralph Fitch also described Goa in the 1580s as "a fine citie, and for an Indian town very faire. The iland is very faire, full of orchards and gardens, and many palmer trees, and hath some villages"⁽⁷⁵⁾. It is likely that these gardens and orchards of the Portuguese settlements at Goa and elsewhere on the western coast of India were points of introduction of maize and other American food plants during the 16th and 17th centuries.

Portugeuse Estado Da India

While they were establishing the *Estado da India* on the western coast of India under the control of the Viceroy at Goa, the Portuguese began to migrate eastward along the coast of the Bay of Bengal. In 1536 the Hindu king of Bengal allowed the Portuguese to establish trading stations at Satgaon (Porto Pequeno) and Chittagong (Porto Grande) at the north end of the Bay. In 1579 the Portuguese established a settlement at Hugli, at the mouth of the Ganges River, and gradually extended minor settlements north to Dacca in present-day Bangladesh. Many European travellers of the 16th century were highly critical of the Portuguese in Bengal, describing them as having " no fortes, nor any government, nor policie as in India, but live in a manner like wild men, and untamed horses, for that every man doth there what hee will, and every man is lord [and maister], neyther esteeme they any thing of justice, whether there be any or none "⁽⁷⁶⁾. European travellers' estimates of the size of the Portuguese population at Hugli in the 1600s vary widely. The best contemporary authority may be Miguel de Noronha, Viceroy of Goa, who reported "no more than 200 Portuguese, and with their Christian slaves would in all make up 800" as the population of Hugli in 1632 ⁽⁷⁷⁾.

Early Portuguese in Bengal

During the 17th century the Portuguese *Estado da India* declined under increasing attack from the expanding Mughal Empire of northern India, and from the Dutch and English East India Companies. In 1632 Qasim Khan, governor of Bengal in the expanding Mughal Empire, attacked and destroyed the Portuguese settlement of Hugli, which thereafter never recovered its early importance. The Dutch took over the most of the Portuguese trade in spices and most of their inter-Asian trade. By 1620 the English East India Company had established settlements in India along both the western and eastern coasts, and inland settlements in cities of the Mughal Empire in northwest India. Calcutta was founded in 1690 at the mouth of the Ganges and became the capital of the British Raj that dominated South Asia into the 20th century ⁽⁷⁸⁾.

Muslim Trade in Asia

The greater number and accessibility of European archives encourage an unbalanced view of the relative importance of Europeans in Asian trade in the Middle Ages. The unique account of the Moroccan Ibn Battuta, who traveled extensively in North Africa and Asia from 1325 to 1354, reveals that Muslims from Arabia (now Saudi Arabia) and Persia (now Iran) controlled the maritime trade between India, the Middle East, and Europe, and also played a large role in the maritime trade with China ⁽⁷⁹⁾. Modern historians have concluded that European trade remained a minor component of South Asian maritime and overland trade during the 16th and 17th centuries of the *Estado da India*. For example, Muslim traders from the Indian State of Gujarat were major competitors with the Portuguese for the spice trade in the Indian Ocean ⁽⁸⁰⁾. In fact, the typical journey of an Italian merchant to India in 1500 was quite similar to that of Marco Polo 300 years earlier. From Alexandria or Damascus on the Mediterranean Sea traders crossed to the Arabian Sea by overland caravan or through the Red Sea or Persian Gulf. At ports such as Aden on the Red Sea or Hormuz on the Persian Gulf, goods were transferred to a larger ship to cross the Arabian Sea to the western coast of India, thence to the Indian Ocean and lands to the east ⁽⁸¹⁾. Marco Polo wrote "Aden is the port to which many of the ships of India come with their cargoes; and from this haven the merchants carry the goods a distance of seven days further in small vessels. At the end of those seven days they land the goods and load them on camels, and so carry them a land journey of 30 days. This brings them to the river of Alexandria, and by it they descend to the latter city. It is by this way through Aden that the Saracens of Alexandria receive all their stores of pepper and other spicery; and there is no other route equally good and convenient by which these goods could reach that place"⁽⁸²⁾. As noted above, the holy cities of Mecca and Medina on the Red Sea coast of Saudi Arabia were a center of pilgrimage and trade for Muslims throughout North Africa and Asia.

Travels of Marco Polo

When the Portuguese arrived in 1500, South Asia was a patchwork of independent kingdoms, largely Islamic in the north and Hindu in the south. The Muslim Sultans of Delhi controlled most of the fertile valleys of the Indus and Ganges Rivers, from present-day northern Pakistan southeast to Bangladesh. In 1526 Zahir-ud-din Muhammad Babur, the Muslim king of Ferghana in present-day Uzbekistan, conquered northern India and founded the Mughal Empire, which eventually controlled Afghanistan, Pakistan, and India south to the 20th parallel. During the 17th century the Mughal capital at Agra became a great center of trade, by caravan and by barge transport on the Ganges River. The Mughal Emperors were passionate gardeners and played a major role in documentation of agriculture and in introduction of new plants into India.

Botany of the Mughal Emperors

In 1530 Babur wrote the *Babur-nama*, the first book on the natural history of India. Babur's extensive records of flowers, and of fruits and other agricultural plants that he saw in India include no mention of any introduced American plants⁽⁸³⁾. In 1595 court historian Abu-l-Fazl published the *Ain-I-Akbari*, a detailed agricultural survey of the provinces of the Mughal Empire. The *Ain* described *ananas* (pineapple) as a fruit that came from Portuguese ports and was served at the table of Akbar. The fact that the Brazilian name of the fruit, *ananas*, was widely adopted in South Asia has facilitated tracing its introduction⁽⁸⁴⁾. However, the only possible mention of maize in the *Ain* has been refuted by Habib. In his 1893 *Dictionary of the Economic Products of India* George Watt wrote that in the English translation of the *Ain* a flower called *kewrah* was described as having leaves like maize⁽⁸⁵⁾. Later authors have cited Watt's note as proof of the existence of maize in India in the 1500s. Habib, however, notes that this is a mistranslation of the original text, which reads *juwari*, which is likely to mean sorghum rather than maize⁽⁸⁶⁾.

Early Maize in South Asia

In his study of manuscript collections and other 17th century sources from western India, historian Parashuram Krishna Gode⁽⁸⁷⁾ discovered references to *makka* or maize. Maize was mentioned as tasteful, strength-giving, and dear to children in a text found in several medical and botanical works published near present-day Mumbai before 1620 and between 1640 and 1700. Maize also was reported in the Deccan region of western India in lists of food taxes between 1630 and 1680 and in a 1707 historical report of the cutting and looting of maize and other crops from farmers' fields. Far to the north in the Kathmandu valley of Nepal, a *Vamsavali* or genealogical history of the Buddhist Malla rajas recorded the introduction of maize during the reign of Jagatjyotir Malla from 1615 to 1627. "In this reign some Indian corn [maize] was by chance brought from the east, mixed up among a quantity of mas or urd-dal [a kind of pulse]. The clever people of the country were immediately assembled, and decided that this new grain would cause a famine, so it was thought best to send it back whence it had come; and to destroy all the ill luck it might have left behind, Brahmans were fed and the gods worshipped"⁽⁸⁸⁾.

Pineapples in India

Few European travellers to India during the 16th century reported American crop plants. Three Portuguese travellers to southern India, Domingo Paes in 1520, Fernao Nuniz in 1535, and Garcia da Orta in 1563, described fruits, grains, and other crops, but did not mention any American plants⁽⁸⁹⁾. In 1578 the Portuguese botanist Christophoras Acosta reported pineapple in western India⁽⁹⁰⁾. In the 1580s, Van Linschoten reported that pineapple was found on the west coast and "was first brought by the Portingalles out of Brasille, so that at the first it was sold for a noveltie...but now there are so many grown in the countrey, that they are very good cheape." Van Linschoten also reported other American food plants- papaya (*Carica papaya*), cashew (*Anacardium occidentale*), and sweet potato- on the western coast of India⁽⁹¹⁾. A manuscript written by Father Antonio Monserrate, which was discovered in a Calcutta church library in 1906, contains a report of maize in northwest India in 1581. In 1580, Monserrate left his post at Goa to join the first Jesuit mission to the court of Akbar at Agra. During Akbar's campaign against Mirza Hakim in 1581, Monserrate traveled with the Mughal army north and west of Agra into the hill regions of Kangra, Kashmir, Swat, and Kabul. He reported that provisions procured locally for the army included "grain, maize, pulse, and all manner of provisions and other merchandise"⁽⁹²⁾.

American Crop Plants in India

Throughout the 17th century, European travellers reported American crop plants in India. In western India, from the Malabar coast and Goa north and inland to Agra, reports include those of Methwold (1615-1622), Terry (1616-1619), De La Valle (1623-1626), Mundy (1628-1634), Tavernier (1631-1661), Fryer (1672-1681), Hamilton (1688+), and Carre (1672-1674). In eastern India, from Sri Lanka north along the Coromandel coast to Bengal, reports include those of Methwold (1615-1622), Manrique (1629-1643), Bernier (1656-1668), Bowry (1669-1674), and Baldeus (1672)⁽⁹³⁾. Pineapple and tobacco were mentioned most frequently, but papaya, cashew, sweet potato, guava (*Psidium guajava*), and chili pepper (*Capsicum annuum*) also were reported. Although none of these travellers mention maize, an intriguing illustration reproduced from the original 1672 text of the Dutchman Philip Baldeus shows natives of Jaffna in northern Sri Lanka presenting various fruits and vegetables, including a clearly distinguishable ear of maize, to a group of Dutch soldiers⁽⁹⁴⁾.

From 1602, missionary priests of the Jesuit and Capuchin orders traversed the Himalayan range in Bhutan, Nepal or Ladakh (now the State of Kashmir) to travel between India and Tibet, and from 1715 to 1769 a mainly Capuchin mission was established in Kathmandu in Nepal. Unfortunately, the priests left few accounts of agriculture in these regions and rare records of American crop plants. Early in the 18th century, Father Ippolito Desideri reported pineapples in Kathmandu and a Father Loro reported maize⁽⁹⁵⁾.

Bogle on Maize in Bhutan

As the British East India Company extended its influence in South Asia, the Panchen Lama of Tibet requested a visit by a Company representative. In 1774, Governor-General Warren Hastings responded by sending George Bogle to discuss issues of trade and diplomatic relations between British India and Tibet. Bogle traveled north from Calcutta through the present-day State of West Bengal, Bangladesh, the State of Assam, and Bhutan to Tashilungpo in Tibet. Bogle introduced potatoes (*Solanum tuberosum*) and other plants and reported on geography, agriculture, and other subjects of interest to the British government. Of the villages in Bhutan, he wrote "The prospect within the hills is confined -not above 25 miles; country all equally clad with wood. There were not above six or eight villages to be seen on the brow of the mountain, with little patches of wheat, barley, or Indian corn"⁽⁹⁶⁾. After Bogle's untimely death at the age of 35 in Calcutta, Governor-General Hastings choose Samuel Turner for a second British mission to

Tibet in 1783. In Assam and Bhutan, Turner reported pineapples growing wild in the forests, tobacco, and chili pepper. In Bhutan he found remnants of the potatoes that Bogle had planted 10 years earlier ⁽⁹⁷⁾.

Kirkpatrick on Maize in Nepal

During the first British mission to Nepal from February to April of 1793, Colonel Kirkpatrick described the grain crops grown on unirrigated hillsides in the Kathmandu valley. He wrote that "the principle are Muckhye [Indian corn], Kodo Murrova (*Eleusine* sp.), some species of Ghya [a dry coarse rice], and Toori (*Brassica* sp.)...These articles are chiefly consumed by the husbandmen themselves, and others among the lower classes of people"⁽⁹⁸⁾.

Buchanan's Travels in India and Nepal

Under the direction of Governor General Wellesley, Scotsman Francis Buchanan (later Hamilton) undertook extensive botanical, ethnological, and general surveys during his two decades (1794-1815) in India. Buchanan traveled from 1800 to 1801 through regions of southern India (now the States of Tamil Nadu, Kerala, and Karnataka) that the British had annexed in 1799 and through adjoining regions. He reported commercial production of tobacco and chili pepper, and cultivation of sweet potatoes and maize throughout the region. Buchanan described a tribe called the Soligaru who lived in the remote mountains west of Mysore, collecting honey and wild yams from the forest, and using shifting cultivation to prepare plots that they "broadcast with Ragy (*Eleusine coracana*), here and there dropping in a seed of Avarat (*Dolichos lablab*), Tovyary (*Cajanas cajan*), mustard, maize, and pumpkin"⁽⁹⁹⁾. Near the city of Bangalore Buchanan found that "The maize thrives better than at Silgutta, growing seven or eight feet high, and producing four or five heads. The gardeners, however, remove all except one; and allege, that the plant is not able to bring more to perfection. The same prejudice against the grain prevails here as elsewhere in this country. When I asked if they ever made it into flour, my question was considered as a joke, or perhaps as an absurdity, at which the people could not help laughing"⁽¹⁰⁰⁾. After his travels in southern India, Buchanan joined the British mission to Kathmandu from 1802 to 1803, and spent an additional two years on the Nepal frontier. Buchanan reported that maize was an important crop in the Jumla district of western Nepal and in the Kathmandu valley, just as Kirkpatrick had observed ten years earlier ⁽¹⁰¹⁾. Farther to the northwest in Kangra (now Himachal Pradesh), Kirkpatrick noted "although most parts of the country are high, the ascents from the plains below are easy, and the summits of the hills are level, so that a large proportion is fit for cultivation, and is well occupied. The poor live much on maize"⁽¹⁰²⁾. During the winter of 1811-1812, Buchanan surveyed the state of Bihar in northeast India, and found "the chief crops seem to be Maize, Orohor (*Cajanus cajan*), Til (*Sesamum*), and Cotton ⁽¹⁰³⁾(103).

Hodgson on Maize in the Himalayas

While he was with the British mission in Kathmandu from 1820 to 1842, and later in the city of Darjeeling just east of the Nepal border, Brian Houghton Hodgson studied ethnography and natural history of the Himalayan region. In Kathmandu, Hodgson noted a "preference for rices, maizes, sorghums, panicums or millets, buckwheat, and amaranth, on the part of the people"⁽¹⁰⁴⁾. During his ethnological studies of the Kiranti tribes of the remote hill regions of eastern Nepal and the Bodo and Dhimal tribes of northeastern India, Hodgson noted the use of shifting cultivation to prepare plots of chili peppers, maize, millets, and rice. Hodgson wrote that, compared to rice, "maize and even millet seem to contribute as much to the quantity of home-reared food"⁽¹⁰⁵⁾. In Darjeeling in 1848, Hodgson assisted botanist Joseph Hooker in preparing for his exploration of the Himalayas. In east Nepal Hooker observed "villages which are merely scattered collections of huts, are surrounded with fields of rice, buckwheat, and indian corn, which latter the natives were now storing in little granaries, mounted on four posts"⁽¹⁰⁶⁾.

Hooker Eats Popcorn in Bhutan

In central Sikkim, Hooker described "scanty crops of millet, maize and buckwheat" and houses hung with "cornucopias of indian corn"⁽¹⁰⁷⁾. In Lachen valley on the Tibet border, Hooker wrote a charming description of what appears to have been his first taste of popcorn "prepared by roasting the maize in an iron vessel, when it splits and turns partly inside out, exposing a snow white spongy mass of farina. It looks very handsome, and would make a beautiful dish for desert"⁽¹⁰⁸⁾. Hooker also reported maize in the mountains of the present-day State of Meghalaya just north of Bangladesh ⁽¹⁰⁹⁾.

Moorcroft on Maize in Afghanistan

British exploration of northwestern India, Pakistan, and Afghanistan was restricted until the mid-19th century because these areas were not under British control or influence. From 1819 to 1825 British agents William Moorcroft and George Trebeck traveled throughout the western Himalayan regions of India, Pakistan, and Afghanistan to Bokhara in Uzbekistan in search of horse breeding stock and evidence of Russian influence. Moorcroft reported crops of maize in the State of Kashmir and in Pakistan, and just west of Kabul in Afghanistan he recorded "Indian corn is cultivated, and although it seldom exceeds three feet in height, yields a return of forty or sixty for one" ⁽¹¹⁰⁾. Following Moorcroft into the western Himalayas were other British travellers who reported maize, including Andrew Adams in Kashmir and Himachal Pradesh in 1849 ⁽¹¹¹⁾ and A. D. Frederickson in Punjab ⁽¹¹²⁾.

Maize as the Food of Hill tribes of South Asia

Contradictory statements appear in the 19th century botanical literature of British India on the prevalence of maize in South Asia. In his description of Indian plants, *Flora Indica*, published in 1832, William Roxburgh, director of the Botanical Garden at Calcutta, wrote that maize was "cultivated in various parts of India in gardens, and only as a delicacy; but not anywhere on the continent of India as far as I can learn, as an extensive crop"⁽¹¹³⁾. In his 1893 *Dictionary of the Economic Products of India*, however, George Watt cited "the extremely local character of the information often supplied by Indian writers" and concluded "It is thus very probable that in Upper India [a region, comparatively speaking, unknown to Roxburgh] maize was much more extensively grown at the beginning of the century than might be inferred from Roxburgh's words". Watt stated further that maize "is a field crop upon which at least the bulk of the aboriginal tribes of the hilly tracts of India are very largely dependent for subsistence. Thus its diffusion over India, during the present century, might almost be said to be one of the most powerful arguments against the statement often made that the Natives of India are so very conservative that they can scarcely be induced to change their time-honoured customs"⁽¹¹⁴⁾.

Chapter 5: Yu mai in China

Maize was cultivated in China during the 16th century, but the precise dates and circumstances of the first introductions of maize into China are not known. The main sources of information on maize in 16th and 17th century China are medical and botanical texts and agricultural records of the Ming Dynasty that ruled eastern China from 1368 to 1644, and rare accounts from early European missionaries and traders. Unfortunately, Chinese and indigenous records of 16th and 17th century agriculture in the far-western Provinces of Qinghai, Xinjiang, and Xizang (Tibet) appear to be rare. Furthermore, European travellers left few accounts of agriculture in far-western China or in the western Provinces of Yunnan, Sichuan, and Gansu until the 19th century.

Early Chinese Names for Maize

Linguistic evidence indicates that maize was introduced into Ming Dynasty-controlled regions of eastern China from regions to the west. Names for maize in Ming Dynasty medical and botanical texts of the 16th and 17th centuries include *fan mai* (foreign or barbarian wheat), *hsi fan mai* (western barbarian wheat), and *Jung shu* (grain of western barbarians)⁽¹¹⁴⁾. Other early names for maize in Ming China were *yu mai* (jade or imperial wheat) and *yu shu shu* (jade grain of Sichuan or jade sorghum), suggesting an association with imperial jade, which was imported into Ming China from the west by two ancient trade routes. A southwestern route led from the Jade Mountains of northern Burma through the western Provinces of Yunnan and Sichuan, and a northwestern route led from Yu-t'ien, the Jade City (now Khotan or Hotan), on the southern edge of the Taklamakan desert in the far-western Province of Xinjiang⁽¹¹⁵⁾. According to Asia scholar Berthold Laufer, other early names for maize were *aiha shu shu* (glass-bead grain of Sichuan) in Manchuria and *erdeni shu shu* (precious grain of Sichuan) in Mongolia. Early names for maize in Tibet and Ladakh, however, appear to refer to the yellow color of the grain rather than its place of origin: *abras mo spos shel* (amber rice) and *mar me bai lo tog*, with what Laufer finds to be a puzzling combination of *mar* (butter) and *lo tog* (crop)⁽¹¹⁴⁾. The odd phrase *mar me bai* may be an attempt to use Tibetan characters to imitate the sound of *ma kai*, the name for maize in the countries along the southern border of Tibet.

The Silk Road

Centuries before Marco Polo's travels in the 13th century, a network of trade routes, now often called the Silk Road, connected the countries of the Middle East and South Asia to the Chinese Empire in eastern Asia. One major route from Iraq and Iran crossed the Pamir

Mountains to Kashgar and Yarkand (now Kashi and Shache) in Xinjiang, where it was joined by southern routes from Afghanistan and Kashmir. From Yarkand the route split to travel along the edges of the Taklamakan desert along a line of oases, either along the north perimeter via Turfan or along the southern perimeter via Khotan, to rejoin at Dunhuang in Gansu, and continued east into the Chinese Empire. Other trade routes crossed the eastern Himalayan Mountains of Nepal, Bhutan, or Burma (now Myanmar) to Xizang (Tibet), Sichuan, and Yunnan. According to Russian historian Emil Bretschneider's translation of the *Ming shi* or History of the Ming Dynasty (1368-1644), "The emperor Yung lo [1403-24] had always been desirous that all countries, even the most distant, should acknowledge his supremacy, and during his reign envoys from the West used to arrive every year. Those foreigners are very fond of Chinese productions, especially silk, and derive benefit from exchanging them with the goods they bring from their countries"⁽¹¹⁶⁾.

Trade Embassies From Mecca

According to the *Ming shi*, trade embassies continued until the end of the reign of the emperor K'ang hi (1662-1723). During the 1500s and early 1600s, numerous embassies arrived from countries of the Middle East, and especially from *T'ien fang*, heavenly square, the Chinese name for Arabia which refers to the square shape of the shrine of the Kaaba in the holy city of Mecca. Tribute from *T'ienfang* included antelopes, camels, horses, lions, ostriches, jade, pearls, precious stones, knives made of fish teeth, fine wool, and other products of the country⁽¹¹⁷⁾. Many cultivated plants from the Middle East and South Asia were introduced to China during the centuries of overland trade. The first recorded introduction was of alfalfa and the grapevine from Iran in the second century B.C.⁽¹¹⁸⁾. In the 17th century, the Ming emperor K'ang hi wrote "I would procure for my subjects a novel kind of fruit or grain, rather than build a hundred porcelain kilns"⁽¹¹⁹⁾. Although we have found no specific references to maize among the trade goods listed in translations of the Ming records, it seems probable that maize and other American crop plants were brought to China by trade embassies from the Middle East or South Asia during the 16th century. As the Ming Dynasty ended after the reign of K'ang hi, China closed its borders, leaving western China inaccessible to Europeans until the mid-1800s.

Missionaries Find Maize in Batang

The occasional Jesuit, Capuchin, and other Christian missionaries who traveled in Tibet and other regions of far-western China from the 17th to 19th centuries left few accounts of agriculture in these regions and rare records of American crop plants. During his travels in Tibet

between 1712 and 1727, Father Ippolito Desideri made some comments on Tibetan agriculture and the prevalence of tobacco smoking, but made no mention of maize ⁽¹²⁰⁾. In the 1840s, the French missionary priests Regis-Evariste Huc and Joseph Gabet traveled in Manchuria (northeastern China), Mongolia, and Tibet. Huc's account of everyday life along their caravan route contained descriptions of agriculture, but only in Batang, on the border of Tibet and Sichuan, did he describe maize, "This plain, which you find, as by enchantment, amid the mountains of Thibet, is wonderfully fertile: it produces two harvests each year. Its principal products are rice, maize, barley, wheat, peas, cabbages, turnips, onions, and several other varieties of vegetables" ⁽¹²¹⁾.

Maize in Taklamakan Desert Oases

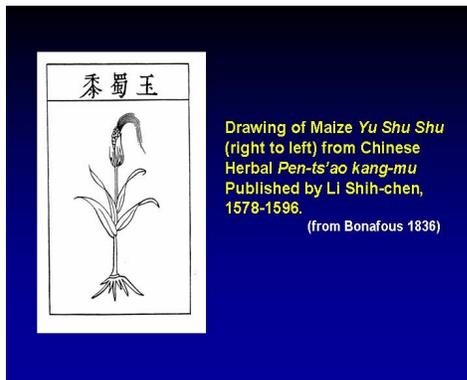
When the borders of far-western China began to reopen in the 19th century, the first British travellers into Xinjiang from India discovered that maize was already well-established at the oases along the perimeter of the Taklamakan desert. During his travels in the western Himalayan mountains, British agent William Moorcroft spent 1820 to 1822 in Ladakh, waiting unsuccessfully for permission from Chinese authorities to cross the Karakoram Range to the Taklamakan region. Native informants reported to Moorcroft that maize was grown in Khotan, which was for centuries the largest and most important cultivated district on the southern edge of the desert ⁽¹²²⁾. In the 1860s, British travellers finally were able to travel from Ladakh into the Taklamakan region. In 1865, William Johnson of the Survey of India reached Khotan and reported that "The chief grains of the country are Indian corn, wheat, barley of two kinds, bajra, jowar [two kinds of holcus], buckwheat and rice" ⁽¹²³⁾. Three years later, British trader Robert Shaw reported maize as a crop in the oasis town of Charchand (now Qiemo) more than 300 miles northeast of Khotan ⁽¹²⁴⁾. According to numerous 19th century accounts, maize was ubiquitous in the oases of the Taklamakan, providing food for the nomadic shepherds of the southern perimeter and feed for caravans of horses and donkeys as far northeast as Dunhuang, near the western end of the Great Wall of China ⁽¹²⁵⁾. For example, in 1895, wealthy English travellers Mr. and Mrs. St. George Littledale purchased 25,000 pounds of maize at Charchand for the pack animals of their unsuccessful expedition to Lhasa, the capital of Tibet ⁽¹²⁶⁾. At the Muslim shrine of Mazar Kum-rabat-padshahim just west of Khotan, it was customary for 19th century travellers to leave maize for the thousands of pigeons as an offering of gratitude at the tomb of the Imam Shakir Padshah. According to folklore, the Imam fell in a battle with the Buddhists of Khotan more than a thousand years earlier ⁽¹²⁷⁾.

Early Maize in Western China

Medical and botanical texts and agricultural records of the Ming Dynasty thoroughly document the introduction of maize from regions of the *Hsi fan*, western barbarians, which includes the provinces of Gansu, Sichuan, Qinghai, and Yunnan, and the presence of maize in some regions of eastern China in the 16th century. Chinese historian Ping-ti Ho noted that throughout the Ming period (1368-1644) "western tribesman, who had a great demand for Chinese fabrics and particularly tea, had been trading their horses for Chinese products at various government trading posts along that thousand-mile frontier. In addition to the thousands who regularly traded at the frontier posts, the number of tribesmen annually bearing tribute to the court at Peking (now Beijing) was unusually large... It is fairly certain that maize was first brought to Peking as tribute by these western tribesmen sometime before the middle of the sixteenth century"⁽¹²⁸⁾. The earliest report of maize in Ming China is in an agricultural history of the year 1555 in the Province of Hunan, and other early reports are in agricultural histories of the years 1563 and 1574 in several western districts of Yunnan. Other records indicate that by the end of the 16th century, maize was being widely grown in Yunnan, Sichuan, and Qinghai, particularly in mountainous regions unsuited to the cultivation of rice⁽¹²⁹⁾. The Portuguese priest Alvarez Semedo arrived in China in 1613 and reported that maize was grown in six provinces near Beijing and was grown at Beijing for the use of the emperor's court and army⁽¹³⁰⁾. Maize and other new crops played an important part in the agricultural settlement of Sichuan in the 17th and 18th centuries, as attested in a local history from 1814 "Our soil is not poor and our people are not lazy. The innumerable immigrants have brought with them every conceivable food plant or product, all of which have been extensively propagated here. Many things that were unknown in the past are now our staple products"⁽¹³¹⁾.

Maize in Early Chinese Text

Chinese medical and botanical texts of the 16th century contain some of the earliest descriptions and illustrations of maize. In the 1572 edition of the *Liu-ch'ing jih-tsa*, the author I-heng T'ien discussed the origin of maize and also provided a rather accurate description of the plant "The stems and leaves are of the same kind as those of the paniced millet, the blossoms like the ears of the rice plant. Its husks are like a fist, and long. Its awns are like red velvet. Its grains are as big as the fruit of the water-plant *ch'ien*, and lustrous white. The blossoms open in the crown, and the fruit appears at the joints"⁽¹³²⁾. In the 1578 first edition of his text the *Pen-ts'ao kang-mu*, Shih-chen Li noted that maize originated from the western regions, but was still uncommon in the eastern Province of Hubei⁽¹³³⁾.



Drawing of Maize"

Li also described various methods for cooking maize, including popcorn ⁽¹³⁴⁾. A later (probably 1596) edition of the *Pen-ts'ao kang-mu* contains a figure of a plant labeled with the three symbols of a Chinese name for maize *Yu shu shu*, and has been cited by many authors as one of the earliest illustrations of maize ⁽¹³⁵⁾. However, although it bears husks and silks typical of maize, the ear is incorrectly located at the top of the stalk rather than at the leaf joint. It should be noted that early botanical illustrations in China as well as in Europe were rarely drawn from actual plant samples, and thus often were not accurate.

The overland introduction of maize to China during the 16th century is strongly supported, but linguistic evidence and the historical record are not sufficient to determine the relative importance of different overland trade routes from the Middle East and South Asia. Although the trade route from northeastern India to Yunnan is the shortest linear distance across the Himalayan mountain range, travel along this route has historically been difficult due to banditry in the region and to the high amounts of rainfall and the deep parallel gorges of the Yangtze, Mekong, and Salween Rivers that must be traversed. Mountain crossings are easier from the Middle East and northwestern India through the physically more accessible passes of Kashmir and Afghanistan into far western China, and trade to China along this route has historically been more significant. Unfortunately, accounts of agriculture in Xinjiang date only from the 19th century when European travellers found maize cultivation at Khotan and other remote oases of the Taklamakan desert. In the late-19th century, the first European travellers found maize cultivation throughout the mountains of western Sichuan and Yunnan ⁽¹³⁶⁾. Of western Yunnan, British agent H. R. Davies wrote "I do not think that I have ever seen such a mass of steep broken hills as this country presents... Maize is the chief thing grown by the few villages that there are" ⁽¹³⁷⁾. When botanist Ernest Henry Wilson traveled westward on the trade route from Chengdu and Batang in Sichuan to Lhasa in Tibet, he reported that the region was populated by a diversity of tribal communities who cultivated maize as their main crop up to elevations of nearly 9500 feet ⁽¹³⁸⁾.

Northwest and Northeast Silk Roads

The precise dates and circumstances of early maritime introductions of maize to China are not known. A major source of misinformation has been the *Historia de las cosas mas notables, ritos y costumbres del gran reyno de la China* (The history of the great and mighty kingdom of China and the situation thereof) which was published in 1585 by the Spanish priest Juan Gonzalez de Mendoza ⁽¹³⁹⁾. Over the past hundred years many authors, including Laufer (1907), Burt-Davy (1914), Ho (1955), Gode (1961), Anderson (1988), and Warman (2003) have cited Mendoza as evidence that by 1577 maize was widely cultivated on the southeastern coast of China and that large amounts of maize were paid as taxes in many provinces ⁽¹⁴⁰⁾.

Mendoza's History of China

Juan Gonzalez de Mendoza wrote his history of China without actually visiting China. According to Asian historian Charles Boxer ⁽¹⁴¹⁾, Mendoza based his history on two eyewitness accounts of travellers to China in the 16th century and on previous histories and other secondary sources. As one primary source, Mendoza used the *Tractado em que se cotam muito por esteso as cousas da China* published in 1570 by the Portuguese priest Gaspar da Cruz who visited the port of Canton (now Guangzhou) in the Province of Guangdong for a few weeks in 1556. Cruz in turn based much of his account on the unpublished narrative of Galeote Pereira, a Portuguese trader who had been captured on the coast of the Province of Fujian in 1549 and had spent three years in prison in China.

Boxer Discovers Early Manuscript

As a second primary source, Mendoza used the unpublished narrative of the Spanish priest Martin de Rada (also called Herrada) who spent two months in Fujian in 1575 and appears to have had access to a contemporary edition of the *Kuang-yu-t'u*, the Ming Atlas, for agricultural statistics. In 1947 at a book sale at an English estate, Boxer discovered a 16th century copy of Rada's original manuscript. In 1953 Boxer published *South China in the Sixteenth Century, being the narratives of Galeote Pereira, Fr. Gaspar da Cruz, Fr. Martin de Rada, 1550-1575*, the first

publication of an English translation of the original narratives of Rada and Pereira ⁽¹⁴¹⁾. Boxer's text now allows a comparison of the original narratives with the Mendoza text as it exists in the 1853 Hakluyt Society edition of the original 1588 English translation by R. Parke.

The first mention of maize in the 1853 English edition of Mendoza's history is "On their high grounds, that are not good to be sowne, there is great store of pine trees, which yield fruit very savourie; chestnuts greater, and of better taste, then commonly you shall finde in Spaine; and yet betwixt these trees they do *sow maiz*, which is the ordinaire foode of the Indians of Mexico and Peru "⁽¹⁴²⁾. The original 1570 Portuguese text of *Tractados das Cousas da China e de Ormuz* states "Os altos, que nam sam tam bons pera pam tem muy fermosos pinhaes, semeando ainda entrelles alguns *legumes* onde pode ser"⁽¹⁴³⁾. Boxer's translation of this text is "The high ground which is not so good for corn hath very fair groves of pine trees, sowing also some *pulse* where it may be" ⁽¹⁴³⁾. Thus, Mendoza has substituted a specific reference to *maize* for a reference to *legumes*, a general term that could refer to a wide range of peas, beans, soybeans and other leguminous plants..

The second mention of maize in the 1853 edition of Mendoza is a list of yearly taxes to the Ming emperor, in which a number of grains are listed including "wheat called Mayz" in the amount of more than "20,250,000 fanegas" (Spanish bushels)" ⁽¹⁴⁴⁾. Boxer notes that the phrase used in the original Spanish edition of Mendoza is "de trigo llamado maiz" which Parke has translated as "wheat called Mayz"⁽¹⁴⁵⁾. Boxer also notes that the original Rada text and the *Kuang-yu-t'u* edition of 1579 have, for this entry in the list of yearly taxes, no specific reference to maize, but rather a general reference to "another kind of grain". Thus, Mendoza appears again to have substituted a specific reference to maize for a general reference to "another kind of grain".

The third mention of maize in the 1853 English edition of Mendoza is in margin notes added by Parke in reference to the text statement that "in this province, and all the rest of the fifteen in that kingdome, they gather much wheate, and excellent good barley, peese, *borona*, millo, frysoles, lantesas, chiches, and other kindes of graines and seedes". Parke added the comment that *borona* was "a sort of grain, resembling maize or Indian corn" ⁽¹⁴⁶⁾. Boxer notes that Minsheu's Spanish dictionary of 1599 defined *borona* only as "a kinde of graine in China"⁽¹⁴⁷⁾. Thus, the term maize is not present in the original Spanish edition of Mendoza's history, but was added by the 16th century English translator.

Although both Laufer and Ho (115) expressed some doubts of the accuracy of Mendoza's statements about maize in China, Boxer has provided convincing evidence that all of the references to maize in Mendoza's history of China are mistranslations of the original documents. Thus, there is no longer any historical reference to a significant introduction of maize to the southern coast of China in the 16th century. Perhaps this should not be surprising since the first Portuguese expedition to Guanzhou was not until 1517, after which official relations broke off for 30 years. Official trade was reestablished only during the 1550s; the first permanent Portuguese trade settlement in China was established at Macau south of Guanzhou in 1557 ⁽¹⁴⁸⁾. By the year 1600 the Spanish were established in the Philippine Islands, becoming additional agents for the maritime introduction of maize across the Pacific Ocean from the Americas.

Chapter 6: Maize in the southeast Asian archipelago and Australia

Maize was being cultivated in the southeast Asian archipelago by the 1600s, and is likely to have been introduced by the Portuguese who established trade settlements at Melaka on the island of Sumatra in 1511, on the island of Timor in 1516, and elsewhere. The basis of Portuguese trade in this region during the 16th and 17th centuries was the exchange of cotton textiles from ports on the eastern coast of India for spices and aromatic woods from the islands of present-day Malaysia and Indonesia ⁽¹⁴⁹⁾. In the early 18th century, after the Portuguese lost dominance of trade among the islands, British trader Alexander Hamilton wrote that "as a monument of their (Portuguese) grandeur then, their language goes current along most of the sea-coast at this time"⁽¹⁵⁰⁾. On his travels from 1854 to 1862 among the islands of Indonesia, British naturalist Alfred Russel Wallace noted that the Malay-speaking natives used a number of Portuguese words, including the Portuguese name *milho* for maize, without "the least notion that these words belong to a European language" ⁽¹⁵¹⁾. In contrast, the Portuguese name *milho* for maize does not appear to have survived on the southeast Asian mainland among numerous local names for maize, such as *ngo te vang*, *khao sali*, and *baogour* ⁽¹⁵²⁾.

Portuguese Trade

Few 16th and 17th century European travellers to the spice islands of Malaysia and Indonesia reported American crop plants. From 1500 to 1521, Portuguese agent Duarte Barbosa made relatively detailed observations of agriculture on the coast of India and as far eastward as Melaka and the Philippine Islands, but made no mention of American crop plants ⁽¹⁵³⁾. Pineapples were reported by Antonio De Morga in the Philippine islands in 1609, by Francois Leguat on the island of Java in 1697, by Allen Catchpoole on the island of Pulo Condore in 1702, and by Alexander Hamilton on Sumatra by 1723 ⁽¹⁵⁴⁾.

Dampier on Maize in Timor

At the turn of the 18th century maize began to appear in the literature of travel and exploration of the southeast Asian archipelago. From 1686 to 1708 the buccaneer and British navy privateer William Dampier made four voyages to southeast Asia. Dampier saved his extensive journals of navigation and natural history and his collections of dried plant specimens from storm and shipwreck by preserving them in lengths of bamboo sealed with wax ⁽¹⁵⁵⁾. On

their 1686 voyage across the southern Pacific Ocean from Mexico to the island of Guam, Dampier's pirate crew came near starvation, "we had not sixty day's provision, at little more than half a pint of Maiz a day for each man, and no other provision, except three melas of salted jew-fish; and we had a great many rats aboard, which we could not hinder from eating part of our Maiz"⁽¹⁵⁶⁾. At numerous islands throughout the archipelago Dampier reported pineapple and tobacco and, to a lesser extent, guava, papaya, and sweet potato. Dampier wrote of the natives of Timor in 1699, "Their common subsistence is by Indian corn, which every man plants for himself. They take but little pains to clear their land; for in the dry time they set fire to the withered grass and shrubs, and that burns them out a plantation for the next wet season. What other grain they have besides Indian corn, I know not. Their plantations are very mean; for they delight most in hunting "⁽¹⁵⁷⁾.

Wallace on Maize in Timor

In Timor 150 years later, Wallace wrote "maize thrives in all the lowlands, and is the common food of the natives as it was when Dampier visited the island in 1699" ⁽¹⁵⁸⁾. In 1703, British trader Catchpoole reported maize and chili pepper on the island of Pulo Condore near the coast of Vietnam ⁽¹⁵⁹⁾. In 1770, botanist Joseph Banks observed that the natives of Java grew maize and the natives of Timor and nearby islands were required to provide maize for provisioning the Portuguese and Dutch settlements ⁽¹⁶⁰⁾. At Guam in 1781, Spanish Captain Francisco Antonio Maurelle procured more than 200 bushels of maize for ship provisions ⁽¹⁶¹⁾. During the search for birds and beetles he chronicled in *The Malay Archipelago* ⁽¹⁶²⁾, Wallace described the adaptability of maize to agriculture in the islands. Maize agricultural systems ranged from the scattered plots of the sago palm-harvesters of Seram and shifting cultivation of head-hunter Dyack tribes of the interior of Borneo, to the gardens of the Malay coffee planters of the volcanic plains of Sulawesi and irrigated mountainside terrace gardens of the Hindu Balinese.

No Maize in Early Records of Northern Australia

Although Portuguese settlements on the island of Timor were less than 300 miles from the northwestern coast of Australia, there is no historical record that Portuguese traders or settlers introduced agriculture to the Australian coast during the 16th and 17th centuries. Malaysian fisherman were another potential means of introduction of American crop plants to Australia, and in 1803 explorer Matthew Flinders found Malaysian fishing boats at Caledon Bay on the northwestern coast⁽¹⁶³⁾. Unfortunately, there are few sources of information on agriculture of the aborigines of the northern Australian coast before British exploration. From 1642 to 1644 the Dutchman Abel Tasman led two exploratory voyages to Australia, including various regions of the northern coast. Although Tasman's original journals were lost, an abridged version of his first

journal has survived. In a handwritten manuscript copy of the journal with English translation, Tasman states that in Australia "people have no knowledge of tobacco or of smoking tobacco" but it is not clear from the text to which part of the country he is referring ⁽¹⁶⁴⁾. Two hundred years later, to explore regions of the country unknown to Europeans, the German Ludwig Leichhardt crossed the continent from Brisbane on the east coast to Port Essington (present-day Darwin) at the northwestern tip of the Northern Territory. In 1845, among aborigines some distance inland from the northwestern coast, Leichhardt found abundant evidence of Malaysian influence, including water buffaloes, rice, tobacco, and clay pipes for smoking tobacco ⁽¹⁶⁵⁾. Leichhardt, however, made no mention of cultivation of maize by the aboriginal tribes he encountered in the northwest. Thus, despite the proximity of Portuguese settlements in Indonesia, there appears to be no direct evidence for introduction of maize to Australia before its documented introduction by the British settlement fleet in 1788.

Early Success of Maize at Sydney

During his first (1768-1771) and second (1772-1775) Pacific voyages, Captain James Cook explored the coasts of New Zealand, Australia, and nearby islands. In January 1788, a British fleet of eleven ships arrived at Port Jackson (present-day Sydney) to establish a permanent settlement and penal colony. In March of the same year, Philip King founded a second settlement on remote Norfolk Island, which was intended as a supply base for British ships ⁽¹⁶⁶⁾. Maize and wheat were planted immediately at both settlements, and by June 1788 at Sydney "Indian corn, and English wheat" promised "very fair"⁽¹⁶⁷⁾. In 1791, however, Captain Arthur Phillip wrote to Joseph Banks, who was the botanist on Cook's first voyage, that maize stood the Australian drought conditions better than wheat. Thus, 351 acres of maize would be planted at Sydney compared to 44 acres of wheat, and the soldiers at the garrison had planted six acres of maize for their own provisions ⁽¹⁶⁸⁾. On Norfolk Island, King reported that maize cultivation was successful, and by 1791 the island settlement was exporting maize to the mainland ⁽¹⁶⁹⁾.

Conclusions

Several independent lines of evidence support the conclusion that *Zea mays* originated only in Mesoamerica. Evolutionary studies indicate that wild species of the genus *Zea*, which are found only in Mesoamerica, are the closest relatives of maize. Botanical studies document that maize is very widespread and extremely diverse in the Americas. Fossil records support an ancient date for domestication of maize in Mesoamerica and nowhere else. Archaeological records chronicle a long history of use of maize among Native Americans. In the historical documents of Europe, Africa, and Asia, there are no definitive records of maize prior to 1492, but there are numerous records of maize dating from the late 15th century. Although some critics have argued for an independent evolution of maize in Asia, or for pre-Columbian diffusion of maize to Asia, the evidence consists largely of folklore and interpretation of ambiguous Indian texts and sculptures. Some critics have even argued that the supposed primitive agriculturalists of Asia could not have adopted and diversified maize in only five centuries, which most experts agree gives far too little credit to the ingenuity of Asian farmers ⁽¹⁷⁰⁾.

Maize is an American Plant

Because maize originated in one geographical area and spread to Europe, Africa, and Asia during the past five centuries, the historical record is an important source of evidence, even though that evidence is often incomplete. Due to the authors' limited linguistic abilities, our access to the historical record has been restricted to European accounts and to English and French translations of Middle Eastern, South Asian, and Chinese documents. For a complete survey of historical records of maize, we will need to develop collaborations with linguists or native speakers who are familiar with Middle Eastern and Asian languages. Due perhaps in part to language limitations, we have been able to identify few 16th, 17th, and 18th century records of agriculture or of American crop plants in the Middle East and in far-western China. In 16th and 17th century India, in contrast, many European travellers report the American crop plants tobacco and pineapple, but few travellers mention maize, even though Indian records document the presence of maize in western India in the 17th century. Perhaps because these early travellers were traders, merchants, and missionaries, they lacked the interest or the botanical expertise to distinguish maize from the diversity of sorghums, millets, and other Indian cereal crops that were unfamiliar to them.

Maize crossed Asia within 100 years

The historical record supports the conclusion that maize spread from west to east across Eurasia and reached China within 60 years of its introduction to Spain soon after 1492. Historical documents and linguistic evidence support the hypothesis that the earliest introductions of maize to eastern Asia were along overland routes of trade between Asian populations and not the result of direct introduction by Europeans. Once maize was introduced from the Americas to the Mediterranean region, it could move rapidly across the west to east axis because it was already adapted to the latitudes and climates of the regions in which it was spreading. For example, the Bahama Islands where Columbus first landed are at the same general latitudes as Egypt, Saudi Arabia, Pakistan, Nepal, Bangladesh, and Yunnan in southwestern China. The spread of maize across Eurasia in the 16th century echoes the well-documented spread of wheat and barley several thousand years ago from the Middle East to Ireland in the west and Japan in the east ⁽¹⁷¹⁾. Accounts of 16th century Muslim and Christian travellers document maize in Ethiopia by the year 1526, and on major trade routes of the Middle East by the year 1574. By the early 17th century, maize was being recorded in western India as *makka* or grain of Mecca, the Muslim holy city in Saudi Arabia. Even three centuries later, variations of grain of Mecca remained as vernacular names for maize throughout the Middle East and South Asia. This linguistic evidence supports a role for Muslim traders in disseminating maize from the Mediterranean region to India and further east. Records of the Ming Dynasty document extensive trade missions in the 16th century from the Middle East and South Asia along the northwestern trade routes of the Silk Road through far-western China. However, we have not found specific references to maize among the trade goods listed in translations of the Ming documents. We have not found any eyewitness reports of maize cultivation along the Silk Road until the early 19th century when the first British agents were permitted to enter far-western China. Although Ming Dynasty agricultural histories support the overland introduction of maize from western regions of China by 1550-1570, evidence is not sufficient to determine the relative importance of the northwestern trade route from the Middle East and the southwestern trade route from northeastern India.

Maize travelled by sea and overland

During the 16th century the Portuguese built a network of trade settlements in Brazil, Africa, and Asia. They discovered Brazil in 1500 and introduced maize, from Brazil or Europe, to the western coast of Africa by 1520-1550 and to the eastern coast by 1620. Variations of the Portuguese name *milho* for maize survive in several African languages. They established the capital city of their *Estada da India* in Goa on the western coast of India in 1510 and small trade

settlements at Bengal on the northeastern coast in 1536. Although the Portuguese coastal settlements are a likely point of introduction of maize, we have found no mention of maize in descriptions of these settlements by 16th and 17th century European travellers. Furthermore, we have found no evidence that the Portuguese name *milho* for maize has survived in any South Asian language. If maize were introduced from Portuguese settlements into the Mughal Empire of northern India, then it could have spread northward to the major trade routes into China. In their eastward search for spices, the Portuguese also established trade settlements on Sumatra, Timor and other islands of the southeast Asian archipelago, where they introduced maize and other American crop plants. Among the natives of these islands, the Portuguese name *milho* for maize has survived. As they continued east, Portuguese traders reached the southern coast of China in 1517, but they did not build a permanent trade settlement until 1557, which postdates the first record of maize in inland China. Fifty years ago, Charles Boxer determined that supposed records of maize in coastal provinces of China in the 16th century are mistranslations of the original Portuguese and Chinese documents. Thus, we have found no reliable historical record of a maritime introduction of maize to China by the Portuguese during the 16th century, whereas the 16th century overland introduction of maize into China is well-documented.

Adaptability of Maize in Asia

The rapid spread of maize in 16th and 17th century Asia was facilitated by its prior adaptation to the latitudes and climates of the region and by the presence of long-established networks of overland trade. The historical record indicates that maize cultivation initially did not displace the long-established and productive irrigated rice systems of coastal India and eastern China, but instead utilized marginal or new agricultural lands. Maize was adopted first by aboriginal tribes and other land-poor farmers in mountainous regions of South Asia and western China. As Buchanan noted in his surveys of South Asia around the year 1800, while the natives of the southern city of Bangalore thought it absurd to consider maize as a cereal grain, the poor farmers of the Himalayan mountains in Kangra and Nepal were already living "much on maize". The extraordinary diversity and versatility of maize contributed much to its success as a new crop in complex Asian agricultural systems with extreme variability in altitude, slope, rainfall, soil, and agronomic practices. As a result, in Nepal today, maize is grown on more than 800,000 hectares comprising 30% of the total cultivated land and remains the staple food of populations in the hill regions ⁽¹⁷²⁾. Yields of maize in Nepal, however, remain very low, averaging less than two metric tons per hectare, as compared to more than eight metric tons per hectare in the United States. The main challenge to maize research in Asia today is to increase the productivity and nutritional quality of an American crop plant that feeds many of the poorest human populations in Asia and throughout the world.

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